

### **REMARKS**

In the Office Action mailed December 20, 2002, Claims 1-4, 8 and 10 are rejected under 35 U.S.C. 102(b) as being anticipated by Hilgendorff et al., "From ZnO Colloids to Nanocrystalline Highly Conductive Films", *J. Electrochem Soc.*, Vol. 145, No 10, Oct 1998, pages 3632-3637. Claims 3 and 4 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hilgendorff et al. Claims 8-10 and 12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hilgendorff et al. in view of U.S. Patent No. 5,716,679 to Krug et al., and U.S. Patent No. 5,089,248 to Akhtar et al. Claims 1-4, 8-10 and 12 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite. Claims 5-7, 11 and 13-14 are objected to under 37 CFR 1.75(c) as being in improper form. Claims 1-4, 8-10 and 12 are objected to because of informalities. The Examiner has also indicated informalities in the drawings and the disclosure, and the lack of an Abstract.

### **Informalities and Objections**

The Examiner has noted that the application has been filed with informal drawings, and states that formal drawings will be required when the application is allowed.

The Examiner has noted that the application does not contain an abstract of the disclosure as required by 37 CFR 1.72(b). Accordingly, an abstract has been added by the instant amendment.

The Examiner has noted that the application does not contain a brief description of the drawings, and that the specification does not contain headings. Appropriate correction has been made in the instant amendment.

### **Rejections under 35 U.S.C. §112, second paragraph**

Claims 1-4, 8-10 and 12 are rejected under 35 U.S.C. §112, second paragraph as being indefinite. Claims 1-2 and 8-10 have been cancelled, thus obviating any grounds for rejection based upon these claims. Claim 3 has been amended to provide proper antecedent basis for "the precipitate." Claims 4 and 12, as amended, depend from Claim 3.

Applicants submit that because of the above-detailed changes, the claims are in compliance with 35 U.S.C. §112, second paragraph, and respectfully request the Examiner reconsider and reverse his rejection of Claims 3, 4, and 12 under

35 U.S.C. §112, second paragraph, as being indefinite.

**Rejections under 35 U.S.C. §102(b)**

Claims 1-4, 8 and 10 are rejected under 35 U.S.C. §102(b) as being anticipated by Hilgendorff et al., "From ZnO Colloids to Nanocrystalline Highly Conductive Films", *J. Electrochem Soc.*, Vol. 145, No 10, Oct 1998, pages 3632-3637. Claims 1, 2 and 8-10 have been cancelled, thus obviating any grounds for rejection based upon these claims. Applicants respectfully disagree with the Examiner's contentions regarding Hilgendorff et al.

The Examiner asserts that Hilgendorff et al. discloses the formation of a suspension of ZnO particles having a particle size of 3 to 6 nanometers in propanol.

Hilgendorff et al. teaches the formation of a precursor sol. In sols, particles with very small diameters are surrounded by a liquid phase. In sols, particles do not flocculate. Therefore, sols are translucent, nanocolloid systems.

Claim 3 as amended, by contrast, is directed to zinc oxide gels having, roughly speaking, a three-dimensional structure. Formation of gels is a step in the process for the preparation of nano size oxide particles.

The Hilgendorff et al. process generates a precursor sol. It is from this sol that a nanocolloid is generated. Hilgendorff et al. does not teach or suggest a precipitate which initially forms during hydrolysis, or leaving this precipitate to mature until the zinc oxide has completely flocculated. The process of Claim 3, as amended, includes both of these elements. In particular, Hilgendorff et al. does not teach carrying out hydrolysis substoichiometric amounts of base, based on the zinc compound, to form a precipitate, as called for in Claim 3. Only when the precipitate which initially forms during hydrolysis is left to mature until the zinc oxide has completely flocculated is it possible to remove all the undesired byproducts, for example, the alkali acetate. This is essential in order to produce very pure zinc oxide gels which are able to redisperse in organic solvents and which can be used directly. The sols obtained according to the cited prior art are not of such a purity, because the steps of formation of a precipitate with substoichiometric amounts of base, maturation, production of a gel and separation of the gel are not included in the prior art process. Hilgendorff et al. neither teaches nor suggests these steps, which are recited in Claim 3. Because of the differences between the products

obtained by the Hilgendorff et al. process and by the present invention, the processes are not equivalent. For these reasons, the reversal of the rejection of Claims 3 - 4, 8 and 10 over Hilgendorff et al. is respectfully requested.

**Rejections under 35 U.S.C. §103(a)**

**a) Rejections over Hilgendorff et al.**

Claims 3 and 4 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hilgendorff et al. Applicants respectfully disagree with the Examiner's contention with respect to Hilgendorff et al.

The Examiner maintains that, though the Hilgendorff et al. compositions differ from the present claims in the characterization of their gel state, it would have been obvious to one skilled in the art to dilute and redisperse the compositions to vary the coating thickness and concentrations.

Claims 3 and 4 have been amended to recite processes for the preparation of nano size zinc particles. The production of a gel is a step in this process. Claims 3 and 4 contain the steps of formation of a precipitate with substoichiometric amounts of base, maturation, production of a gel and separation of the gel. Regardless of the characterization of the gel state produced, Hilgendorff et al. does not teach or suggest the remaining steps.

Consequently, the Hilgendorff et al. compositions differ from those of the present claims in ways other than the characterization of the gel state. The present invention provides a nano size zinc oxide which combines strong UV absorption even in the UV-A region with excellent dispersion properties for minimal scattering. The nanosize zinc oxide produced by the present process has an average particle diameter between 5 and 15 nm, and is produced from commercially available, cost-effective starting materials on an industrial scale at low cost in a manner which permits the zinc oxide, following preparation, to be separated from the by-products without the particles undergoing irreversible aggregation and, following redispersion, to be prepared for further use in sols without laborious grinding. The particles can be redispersed completely to give largely primary-particle-disperse zinc oxide sols, without a significant loss in quality with regard to the monodispersity and size of the particles.

Therefore, dilution and redispersion of the respective compositions will not produce the same results. The sols obtained according to the prior art differ in purity from those produced by the present invention.

Because Claims 3 and 4 are process claims, and recite steps not taught by Hilgendorff et al., they are not anticipated by Hilgendorff et al. In addition, because of the differences between the products obtained by the Hilgendorff process and by the present invention, the processes are not equivalent. For these reasons, the reversal of the rejection of Claims 3 and 4 over Hilgendorff et al. is respectfully requested.

b) Rejections over Hilgendorff et al. in view of Krug et al. and Akhtar et al.

Claims 8-10 and 12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hilgendorff et al. and further in view of U.S. Patent No. 5,716,679 to Krug et al. and U.S. Patent No. 5,089,248 to Akhtar et al. Claims 8 and 10 were cancelled, thus obviating any grounds for rejection based upon those claims. Applicants respectfully disagree with the Examiner's contention regarding the cited art.

The Examiner characterizes Krug as disclosing zinc oxide sols having a 3 nanometer particle size, which are then incorporated in coating compositions. The Examiner characterizes Akhtar as teaching the deposition of zinc oxide optionally with indium or aluminum at concentrations of 1 to 4 molar % based on the zinc, and the use of dichloromethane as a suitable solvent for deposition.

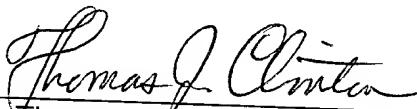
Claims 8-10 have been cancelled in this Amendment. Claim 12 is drawn to a process for the preparation of nano size zinc oxide particles, rather than to the particles themselves. None of Hilgendorff et al., Krug et al. and Akhtar et al. have bearing on the present inventive process, because they only describe sols which are obtained in a known manner by basic hydrolysis. The inserted zinc compounds and the diameters of the zinc oxide particles may be comparable to the process of the present invention, but the preparation methods used to obtain zinc sols are different from the method described in the present application for the preparation of zinc oxide gels. None of Hilgendorff et al., Krug et al. and Akhtar et al. teaches a method making use of zinc oxide gels to prepare nano size zinc oxide particles. For these

reasons, the reversal of the rejection of Claim 12 over Hilgendorff et al. in view of Krug et al. and Akhtar et al. is respectfully requested.

### CONCLUSION

Applicants have cancelled Claims 1-2, 7-10 and 14, added new Claims 15-17, and amended Claims 3-6 and 11-13, and also added section headings, an abstract, and a brief description of the drawings to the specification. Applicants contend that such amendments find support in the specification, and add no new matter. Applicants submit that the present application is in condition for allowance. Accordingly, reconsideration and a Notice of Allowance are respectfully requested for Claims 3-6, 11-13 and 15-17. If the Examiner is of the opinion that the present application is in condition for other than allowance, he is requested to contact the Applicants' attorney at the telephone number given below so that additional changes to the claims may be discussed.

Respectfully submitted,

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NANOPARTICULATE, REDISPERSIBLE ZINC OXIDE GELS

ABSTRACT OF THE DISCLOSURE

A method for the preparation of nano size zinc oxide particles having an average primary particle diameter of less than or equal to 15 nm, which are redispersible in organic solvents and/or water, by basic hydrolysis of at least one zinc compound in alcohol or an alcohol/water mixture. The hydrolysis is carried out with substoichiometric amounts of base, based on the zinc compound. The precipitate which originally forms during hydrolysis is left to mature until the zinc oxide has completely flocculated. This precipitate is then thickened to give a gel and separated off from the supernatant phase.